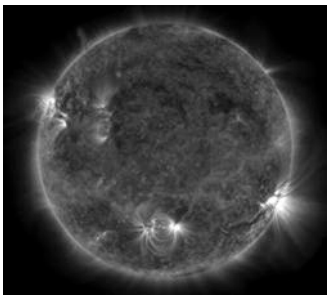
The Sun



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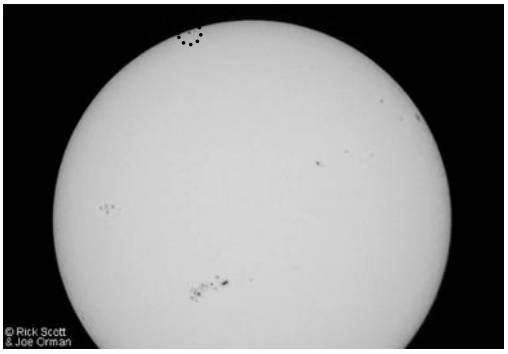
The Sun (*"Sol"*)

- a very "*average*" star
- composed primarily of *hydrogen, helium*
- contains *99.9%* of mass in *solar system*

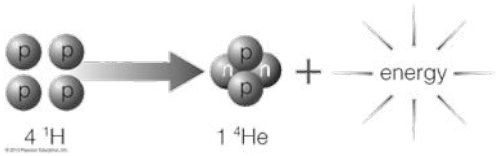
- is ~ ***4.6 billion years old*** (like the *solar system*)

The Sun is very large…



Q: *How* does Sun **generate** the energy it emits?

- Sun fuses *600 million metric tonnes* of ***H*** per sec

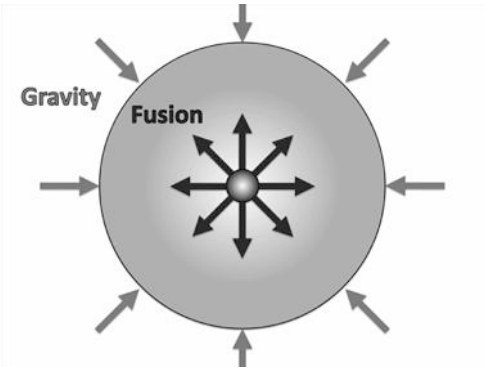


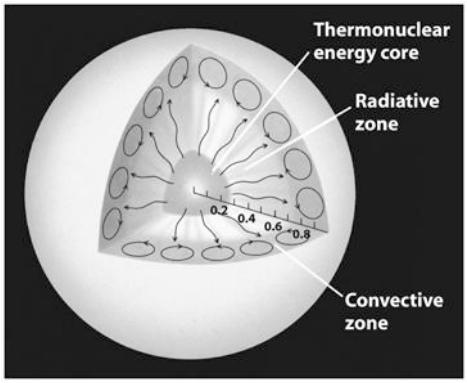
DEMO: *electrostatic forces*

- *mass* is converted to *energy:* $E = mc^2$

(eg) *1 kg* of ***H*** ⇒ ***He*** *equals 20,000 tons of coal*

- ***fusion*** only occurs in the Sun's ***core*** - ***Why****?*

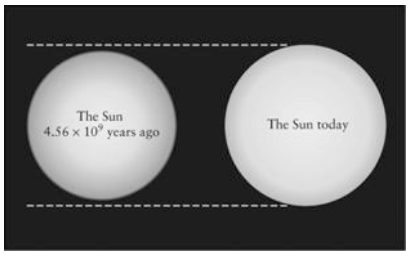




- order of 10^5 *years* for energy *to reach* the surface

Long Term Changes

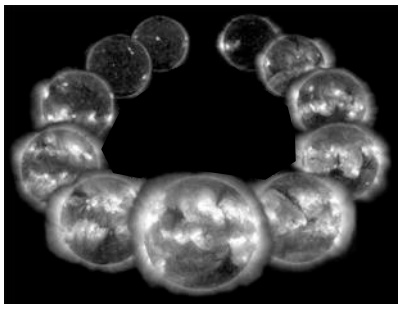
• Sun has converted ***H⇒He*** for 4.6 billion years



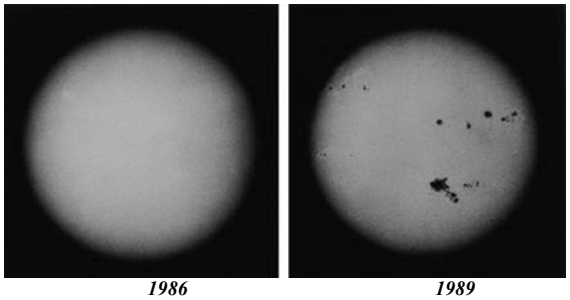
• ***increase*** in ***L*** *+35%*, ***size*** *+6%,* ***T*** *+300 K*

Solar Cycle

• Sun has a *magnetic field* which varies *periodically*

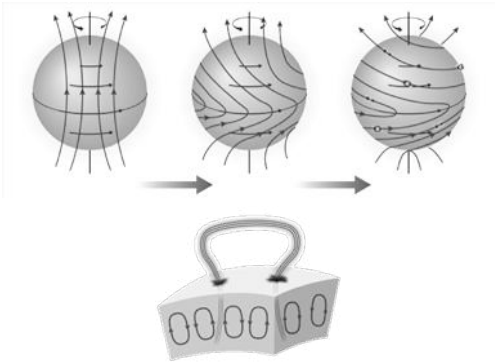


Sunspot variation



1986 ***1989***

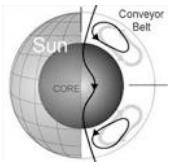
Sunspot Origin

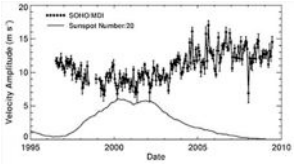


Sun's "Great Conveyor Belt"

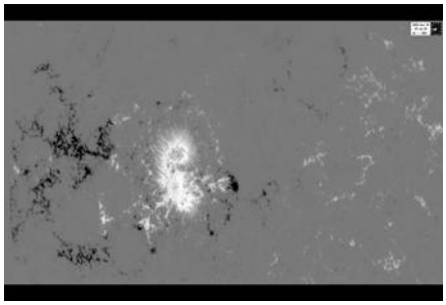
• *convective plasma* motion with *40 year period*

• believed to influence *solar cycle* & *sunspot formation*

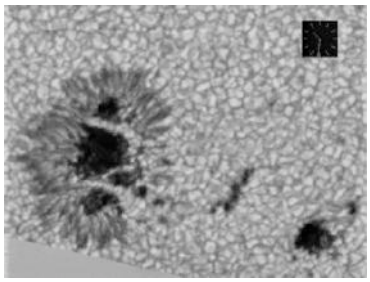


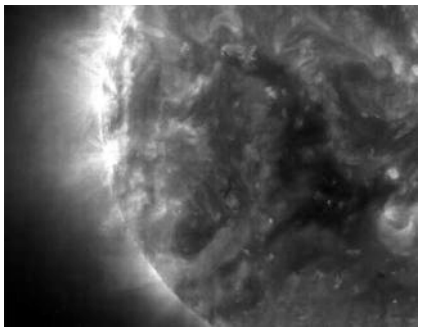


Sunspot Formation

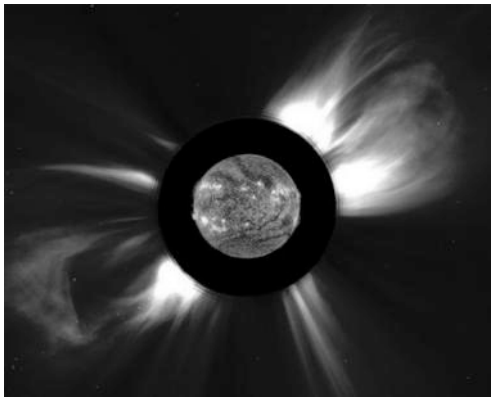


Sunspot Close-up





- *Nov 4, 2003, X class flare in EUV from group 486*
- *"noise" is energetic proton hits (~450 km/s)*



Solar Eruptions

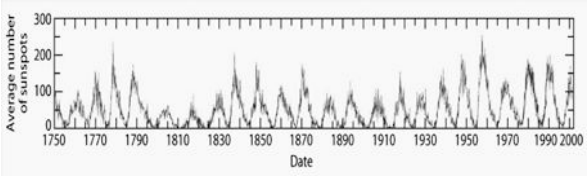
- ***CME*** and ***flares*** can be incredibly *powerful*

(eg) *"Carrington Event" of 1895 electrified transmission cables, set fires in telegraph offices, and produced Northern Lights so bright that people could read newspapers by their red and green glow.*

- such an event today: ***trillions*** in damage (?)

Questions?

Student Exercise



- determine *solar-cycle* (peak-to-peak) ***duration***
- determine ***when*** *next peak* will occur
- determine ***minimum peak sunspot number***